Evaluating the BLS labor force projections to 2000

BLS labor force participation rates were high and census population projections were low, resulting in relatively accurate labor force projections to 2000

Howard N Fullerton Jr.

The Bureau of Labor Statistics (BLS) has made labor force projections since the late 1950s. Data for these projections are based on age, sex, race and Hispanic origin. Beginning in 1968, BLS has reviewed and evaluated past labor force projections to determine closeness to the actual figures. Such evaluations help both individuals making projections and those using the projections to understand the sources of error and the accuracy of specific components.

BLS projected the 2000 labor force at five different times, roughly 2 years apart. Of these 5 projections, 3 had errors of a million or less; the most extreme errors ranged 1.5 percent above or below the actual 2000 labor force of 140.9 million. The growth rate of the labor force is crucial to the BLS employment projections program. The error in the growth rate varied by a tenth of a percentage point above or below the actual growth rate for the periods over which the projection was made. At the same time, projections of the civilian noninstitutional population were uniformly low. Thus, the labor force participation rate projections were generally too high.

Until recently, BLS projections focused on years divisible by five, so evaluations took place at 5-year intervals. This article is an evaluation of the BLS labor force projections to 2000. Beginning in 1986 and continuing to 1994, BLS prepared five projections either to 2000 or through 2000.[1] This article examines the difference between the projections and the labor force as estimated in the Current Population Survey (CPS) using weights from the 1990 census. The differences, or errors, are calculated by sex for detailed age groups of the white, black, Asian and other, and Hispanic origin population and labor force. (These earlier projections did not have as much age detail for Hispanics as for the other groups.) Each of the five projections to 2000 had three alternatives: high, moderate, and low. This analysis, for the most part, focuses on the middle or "moderate" growth projection in each series. Where appropriate, the accuracy of the five 2000 projections are compared with evaluations of BLS projections to 1985, 1990, and 1995. Each of the projections is identified by the year from which the projection was made (1986, 1988, 1990, 1992, and 1994).[2]

One of the challenges in evaluating projections is that the estimates for 2000 are not strictly comparable with the data projected. For example, after the 1990 census, extensive changes to the CPS were implemented in 1994. These changes included an adjustment for the undercount, as well as changes in the questions asked. The latter resulted in a greater proportion of women and older persons being counted in the labor force. It is not possible to quantify the effect of these improvements in the survey, so it is not possible to know how much they affect projection accuracy. However, it is clear that projections made before 1994 did not anticipate the effects of the redesign and that projections made after 1994 did not immediately incorporate all the changes.

Another challenge in evaluation is that no one measure of error or quality satisfies all users of the labor force projections. Some use the total labor force—or even the growth rate of the labor force—not needing any of the components. For many users, some part of the labor force is vital,

Howard N Fullerton Jr. formerly was a senior demographic statistician in the Office of Occupational Statistics and Employment Projections, Bureau of Labor Statistics.

for example, youth workers or older workers. Others use the projected labor force participation rates to conduct market research or to project State populations. Another group of users focus on the distribution of the labor force by race and sex.

Still another challenge is that there are two sources of possible error in projecting the labor force: the projected population and the projected labor force participation rates. It would be helpful to know how these series combine to produce the errors in the labor force projections.

This article first examines the error in the aggregate labor force, both in the levels and in the growth rates. It then examines errors in the projection of the population and errors in labor force participation rates. Finally, this article analyzes labor force errors, including issues of distribution and levels among demographic groups.

Aggregate 2000 projections

Evaluation of the aggregate 2000 labor force projections reveals that the overall errors were greatest in 1986 and 1990; except for these 2 years, the errors were less than 1 percent. The following tabulation shows the projections to 2000 (in millions), and the numerical and percent error made in each year the projections were based:

Projection for 2000 made from—	*Labor force*	*Error*	
		Millions	*Percent*
1986	138.8	–2.1	-1.5
1988	141.1	.3	.2
1990	142.9	2.0	1.5
1992	141.8	1.0	.7
1994	140.0	–.9	–.6
Actual:			
2000	140.9	…	…

The error information in the tabulation indicates that the short, versus long time-span does not seem to be a factor in improving the accuracy of labor force projections. A similar conclusion would be inferred from earlier analyses. (The first three projections also were evaluated for 1995. The overall errors were greatest in 1986 and 1990; for the other years, the errors were less than 1 percent. It is interesting to note that the numerical errors are less for 2000 than those for 1995 with the 1988 and 1990 projections. It is possible for a projection to improve with age.)

For some users, the absolute error or the percent error is not relevant, but the error in the growth rate is. The following tabulation displays the historic growth rate for the civilian labor force, the projected annual growth rate, the actual growth rate, and the error in the growth rate. All three rates in a row are measured over the same number of years. The historic rate is calculated over the same number of years *before* the date of the projection, as 2000 is *after* the date of the projection:

Projection for 2000 made in—	*Historical rate*	*Projected rate*	*Actual rate*	*Error*
1986	2.2	1.2	1.3	–0.1
1988	2.0	1.2	1.2	.0
1990	1.6	1.3	1.1	.1
1992	1.5	1.3	1.2	.1
1994	1.2	1.1	1.2	–.1

The error in the annual growth rate from 1988 was actually 0.02 percent. For four other projections, the error in the annual growth rate was either –0.1 or 0.1. For individuals using the projections to forecast either employment or economic growth, this level of error would be minor. For growth rates, BLS projected variously that the rate of growth would slow significantly from past rates of growth (by a full percentage point in the 1986 projection) to not much different from past rates of growth (by a tenth of a point in the 1994 projection). Except for the 1994 projection, when BLS projected a decrease in the growth rate and the labor force continued to grow at past rates, the change was in the correct direction and the error in the growth rate was less than the projected change in the growth rate.

Population projections

BLS labor force projections are prepared using the incidence method: the labor force participation rates by age, sex, race, or Hispanic origin are multiplied by comparable projections of the population, prepared by the Census Bureau.[3] BLS adjusts the resident population, provided by the Census Bureau, to get figures of the civilian, noninstitutional population. Although errors were made in making this adjustment, they are not considered to be sufficiently large to incorporate into this analysis. Some sense of the size of this type of error may be garnered by seeing how the errors in the adjusted population varies for the first two labor force projections. For the projection from 1994, the projected population also was adjusted for the 1990 undercount, as the CPS itself was so adjusted.

Population projections have three components: births, deaths, and net immigration. Each of these may be a source of error, as well as the initial population from which the projection is made. Because these projections spanned a period of less than 16 years, errors in births did not affect the size or composition of the labor force. Although it is true that there were fewer deaths than projected, most of those extended lives occurred at older ages when persons are less likely to be in the labor force. The source of the discrepancy must be net immigration either over the projection or as part of the estimate of the base year population. If so, then errors would be larger for Hispanics and Asian and others. The Census Bureau prepares its own evaluation of their population projections; this article examines only the population projections as they affect the size and composition of the labor force.[4]

Error for the population projections. For the past decade, population growth has accounted for more labor force growth than has the labor force participation rate change. Thus, the accuracy of population projections should be crucial to the accuracy of the labor force projections. The following tabulation shows the 2000 projections for the civilian, noninstitutional population aged 16, and the errors associated with the total population projections:

Projections for 2000 made in—	*Total*	*Error*	
		Millions	*Percent*
1986	204.7	–5.0	–2.4
1988	204.6	–5.1	–2.4
1990	208.0	–1.7	–.8
1992	208.0	–1.7	–.8
1994	208.8	–.9	–.4
Actual			
2000	209.7	…	…

Unlike the labor force projection, all the population projections were low. Unlike the labor force projections, the population projections show steady improvement. The difference between the percent errors in the first tabulation (page 4) and this one indicate that BLS made offsetting errors in labor force participation rates, reducing the errors in the aggregate labor force. The following tabulation presents hypothetical labor force projections using the projected population and the actual 2000 labor force participation rates:

Projections for 2000 made in—	*Total (in millions)*	*Error*	*Difference from actual error*	*Percent error*
1986	136.9	–3.9	–1.8	–2.8
1988	136.8	–4.0	–4.3	–2.9
1990	139.5	–1.3	–3.4	–1.0
1992	139.2	–1.6	–2.6	–1.9
1994	140.4	–.5	.4	–.3

The numerical errors made in this hypothetical projection are less than those for the population (previous tabulation). Except for the projection from 1994, these projections would have a larger error than the projections that were made: the labor force would have been even smaller. The percent errors for these hypothetical labor force projections were different from those for the population projection and, except for 1994, the percent errors for the hypothetical labor force projections were greater.

Errors by sex, race and Hispanic origin, and age in the population projections. To trace errors in the population projection, the mean absolute percent error (hereinafter referred to as "mean error") may be calculated at differing levels of aggregation. Table 1 provides the mean errors for several of the various aggregations (in percent). The mean error for aggregate population is the absolute value of the percent error. The mean error for men and women considered separately averages to the aggregate mean error, so they are not displayed in this table. When mean errors are calculated for the three race and one Hispanic origin groups, they are larger than the aggregate error, but the relative standing of the various projections does not change. The errors made when projecting by race offset each other. Therefore, the projection with all race/ethnicity groups separated out is more accurate than that implied by the error associated with any single race/ethnicity grouping. When sex and race are considered together, the mean errors are lower than the error associated with race alone for the first two projections and about the same as those for the last three projections of the population. Finally, accounting for age, sex, and race results in a larger aggregate error than any of the other groupings considered. Examination of the detailed projections does not indicate that using more aggregated age groups would have increased the accuracy of the overall projections.

The population of both men and women were underprojected. A closer examination reveals that the difference was greater for men than for women through the projection from 1990. The first two projections had markedly larger projection errors than the last three. That the error was larger for men than for women reflects the greater tendency for men to be undocumented immigrants, thus, it is likely that the errors attributed to underestimates of undocumented workers decreased because population projection errors reduced as time passed. All five projections correctly projected that there would be substantially more women than men in the 16 and older population.

For all five labor force projections (three population projections), the size of the white population was underprojected. As whites made up 84 percent of the population in 2000, they should also account for most of the error. Generally, however, it is easier to measure and project large groups. For all the projections, the errors for the white labor force projections were less than 84 percent of the error. Except for the projection from 1990, whites accounted for more than half of the projection error.

Two population groups would be expected to be hard to project: Asians and others and Hispanics. Both groups have high immigration, are fairly heterogeneous, and are relatively small. Asians and others accounted for 5 percent of the 16 and older population in 2000, but for each of the projections, the first population projection, they accounted for 27 percent of the error. For the next population projection, their numerical error slightly exceeded the error for whites. For the fifth population projection, the errors were much smaller, accounting for 16 percent of error. However, their projected population was higher than actual, unlike the other three groups.

Hispanics may be of any race, however, more than 90 percent are white. Thus, errors in projecting the numbers of Hispanics

Table 1. Mean errors for various aggregations, projections for 2000 made in 1986–94

[In percent]

Category	Projection for 2000 made in–				
	1986	1988	1990	1992	1994
Aggregate error	2.4	2.4	0.8	0.8	0.4
Mean error for—					
Race	6.4	6.4	4.3	3.5	1.5
Sex and race	5.5	5.6	4.2	3.4	1.5
Sex, race, and age	7.6	7.7	6.3	4.1	3.6

carry into the number of whites. It should be no surprise that the Hispanic population is difficult to project accurately because Hispanics have high immigration rates and it is estimated they are a large component of undocumented immigration. Hispanics accounted for 11 percent of the 16 and older population in 2000. Errors in their population projection accounted for 38 percent of the error from 1986 and 37 percent of the projections from 1988. For the labor force projection from 1990, which used the same population projection for Hispanics as the previous two, the error was the same size (1.9 million low), but it now exceeded the total population error (1.7 million low). This projection was not based on the 1990 census. The 1992 and 1994 projections were the relative size of the projection errors decreased. Even so, the error in the number of Hispanics exceeded that for whites in the projection from 1992. The dynamic changes in the Hispanic population are reflected in the difficulties of projecting this group.

For the first two population projections (first three labor force projections), the black population had relatively small errors—less than their share of the population, which is 12 percent. This population group, though growing faster than the overall population, has demonstrated a consistent path of growth. The black population was the most accurately projected group in the projections from 1994. For the projection from 1992 the error was much larger, and accounted for 30 percent of total error. For the projection from 1994, although the size of the numerical error was smallest of the five (because the total error was by far the smallest), the black's share of the projection error was larger than their share of the population.

Errors by age, sex, and race or Hispanic origin in the population projections. For each of the five population projections, there are 108 errors to examine at the level of age, sex, race or Hispanic origin. Table 2 provides summary information about the depth and dispersion of the errors, in thousands. It indicates that the population was underprojected. The middle, half-way points, or medians are negative. For the first population projection, three-quarters of the population errors were negative. It is apparent from the three lines of error dispersion that the more recent projections had a smaller range of errors. Indeed, the ranges of errors dropped by a third. The decrease in dispersion is larger that the change in the medians of the errors.

Which groups had the lowest underprojection? For the projections from 1986 through 1992, it was white men ages 20 to 24. For the projection from 1994, it was Hispanic women ages 25 to 34. (The error for this group of women was always in the lowest one-eighth.) White men ages 20 to 24 consist of a large group with a large absolute error, but their relative errors are smaller. The relative errors for Hispanic women ages 25 to 34 are larger than those for white men ages 20 to 24. Hispanic men ages 20 to 24 also have large errors—absolute and relative—for the 1986 population projections. Nevertheless, errors in projecting the size of the 20- to-24 and 25- to-34-year old Hispanic population also affected projecting the size of the white population of the same age.

Which groups were the most overprojected? This varied by year. For the 1986 population projection, it was white men ages 50 to 54. For the 1988 population projection, it was white men ages 30 to 34, followed by white men, 35 to 39. For the 1994 projection, Asian and other women ages 50 to 54 were the most overprojected group. Again, white men are a large group and the source of a large error. Also for the 1994 projection, Asian and others were overprojected as a group. White men's age groups were over- and underprojected, by large amounts, but the population of older white men was uniformly overprojected.

At this point, it is clear that the population projections were too low; given that the aggregate labor force projections were much more accurate, it is easy to infer that the projected labor force participation rates must be too high. It is not clear what effect the errors in the population projections had on the distribution of the labor force by race or sex. That question must be answered after examining the labor force participation rate projections.

Table 2. Summary of depth and dispersion of errors in projections for 2000 made in 1986–94

[In thousands]

Category	1986	1988	1990	1992	1994
	Depth				
Lowest	–965	–958	–622	–495	–273
Lowest one-eighth	–167	–167	–114	–106	–53
Lowest quarter	–100	–108	–56	–44	–25
Half (median)	–36	–36	–22	–6	–10
Highest quarters	–1	–1	23	16	8
Highest eighth	41	41	53	33	24
Highest	136	137	226	195	75
	Dispersion				
Inner 50 percent	100	107	78	59	33
Inner 75 percent	208	208	167	139	76
Range	1,101	1,095	848	691	348

Labor force participation rates

Aggregate measures of labor force participation. What BLS brings to the labor force projection process is its projection of labor force participation rates. Although the population projections currently account for most of projected labor force change, study of the errors made in projecting the labor force participation rates is important also.

Four of the five labor force participation rate projections had the aggregate labor force participation higher than the actual. As table 3 indicates, the aggregate labor force rate has yet to reach 68 percent, though three of the projections anticipated that this would happen by 2000. Given that 2000 was the last year in a sequence of high economic growth, it is significant that the projected labor force rates were higher than the actual. From the projection made in 1988 up to 1994 the error in the aggregate labor force participation rate decreased for each projection. However, the 1986 projection was the second most accurate. Comparing women and men, it is clear that men's rates were more accurately projected than those of women. All the projected participation rates for women were high. As the labor force rates of men change more slowly than those of women, it is easier to accurately project their labor force participation rate. This slower rate of change for male rates may be ending at the older ages. A variety of incentives exist that could result in higher labor force participation rates for retirement age men. These include a change in the normal retirement age under Social Security, and a switch from defined benefit to defined contribution retirement plans.

Sex and race or Hispanic origin. Mean absolute percent errors may be calculated also for the labor force participation rates. For the aggregate error, they are the absolute value of the relative errors. (See table 4.) Errors by gender provide little additional information beyond that for aggregate error—the greatest difference from the aggregate error occurs with the projection from 1994, which had the rate for women too high and that for men too low—because there is no reward for offsetting errors. The mean absolute percent error for race indicates that the worst projection was the one from 1994. Labor force rates for the four race and Hispanic origin groups shows that the percentage point error for 1994 was zero for whites—their best projection—but that the projection from 1994 was by far the worst for blacks, Asians and others, and Hispanics. The mean absolute percent errors were not weighted by size of group. Whites were 83 percent of the 2000 labor force, so that for weighted measures of error, the most accurate year for the overall labor force would be the most accurate year for whites. For the mean absolute percent error by race and gender, the projection from 1988 was least accurate. It was not the case that a good projection for men implied a good projection for women, but certainly the converse was not true. (The correlation of men and women's errors is 0.33.) When the age structure is also considered, then the projection from 1986 had the greatest mean absolute percent error. The projection for this year also had the greatest numerical error. Both the population and the labor force participation projections contributed to this error in the 1986 projection, with the population too low and the participation too high.

Table 3. Projections of the 2000 labor force participation rate, by sex and percentage point errors, 1986–1994, and actual

Projections for 2000 made in—	Total		Men		Women	
	Percent	Error (in percentage points)	Percent	Error (in percentage points)	Percent	Error (in percentage points)
1986	67.8	0.6	74.7	0.0	61.5	1.3
1988	69.0	1.8	75.9	1.2	62.6	2.4
1990	68.7	1.5	76.0	1.3	62.0	1.8
1992	68.2	1.0	75.3	.6	61.6	1.4
1994	67.0	–.2	74.0	–.7	60.6	.4
Actual	67.2	…	74.7	…	60.2	…

Table 4. Mean errors for various aggregations of the projections for 2000, by sex, race, and age

[In percent]

Category	Projections for 2000 made in—				
	1986	1988	1990	1992	1994
Aggregate error	0.9	2.7	2.3	1.5	0.3
Mean error for–					
Sex	1.1	2.8	2.4	1.6	.8
Race	1.2	1.9	.9	.8	3.1
Sex and race	4.4	5.9	2.8	2.1	3.0
Sex, race, and age	14.5	9.8	5.7	6.2	5.1

The labor force participation rate projections from 1994 had the lowest error for whites, but had the worst errors for other race groups. Because whites make up the majority of the labor force, the 1994 projection had the lowest error in labor force participation rates. By contrast, the 1986 projection had large errors in both the population and labor force participation rate projections.

Age, sex, and race or Hispanic origin. Overall, there are 108 labor force participation rate projection errors to examine. Table 5 summarizes the cumulative errors for those categories, ranked from most negative to most positive. The aggregate labor force participation rates were too high in 4 of the 5 projections; the median of the errors of the age-sex-race or Hispanic origin participation rates were closer to zero than the errors of the aggregate, with the exception of the most recent projection. If the thesis is that the labor force participation rates were too high to offset population projections that were too low, then 4 projections of the 5 fit that mold. This information is also

available in chart 1 (top panel), which has box-and-whisker plots for the five projections. (See box on page 10.)

One desirable characteristic of the projections as a sequence would be that the dispersion of the errors would be less for the more recent projections. The measures of dispersion in table 5 (bottom) and chart 1 (top panel) indicate that this was taking place until the 1994 projection. That the most accurate projection is not the most recent made seems to be a characteristic of labor force projections, this also happened with the projections to 1990 and 1995.

Which groups had the worst labor force participation rate projection error? The following tabulation illustrates the answer to this question for each projection.

Projection from—	*Most overprojected*	*Most underprojected*
1986	Black men 18 and 19	Asian and other men 60 and 61
1988	Black men 18 and 19	Asian and other men 65 to 69
1990	Asian and other women 16 and 17	Hispanic women 45 to 54
1992	Black men 60 and 61	Black women 25 to 29
1994	Asian and other women 50 to 54	Hispanic men 60 to 64

The pattern here implies that small groups are hard to project. For half the groups, 2 years of errors occur. With the exception of black women 25 to 29, the remaining groups are small.

"Were some age groups harder to project than others?" To examine this question, chart 1 (middle panel) presents box-and-whisker plots of the errors by age-sex-race/Hispanic origin groups. (We have six projection errors for white women ages 20 to 24, six for black women of the same age, and so on.) Although the median of the errors by projection year are near zero, except for the 1994 projection, the data by age indicate that there was significant variation in the errors by age. For the 25- to-54-age group, which exhibits the highest labor force participation rates, the median of the errors were either high or near zero, giving the source of the high aggregate labor force participation rates. For the older ages, the median of the errors was below zero. For these age groups for which there is now great interest in their pattern of labor force participation, there was a consistent pattern of labor force participation projections that were too low. Labor force participation rates for older men increased from 1985 to 1990, then decreased until 1994 and have increased since then. These changes did not start at the same time for all groups of older men. Starting with the 1996 labor force projections, BLS has projected this change in trend. (It was among the first to do so.)

According to the box-and-whisker plots of labor force participation rates by age group (chart 1, middle panel), it is clear that the age groups younger than 60 were overprojected. The labor force participation rates for groups older than 60 were uniformly underprojected. Some age groups were harder to project than others. The two age groups with the largest boxes were those 18 and 19 and 65 to 69. The latter group had the most extreme errors. However, the extreme errors for those 65 to 69 were high—for Asian and other men in the 1986 projection and Asian and other women in the 1988 projection.

Table 5. Summary of errors in the components of the labor force participation rates, for 5 years of the 2000 projection

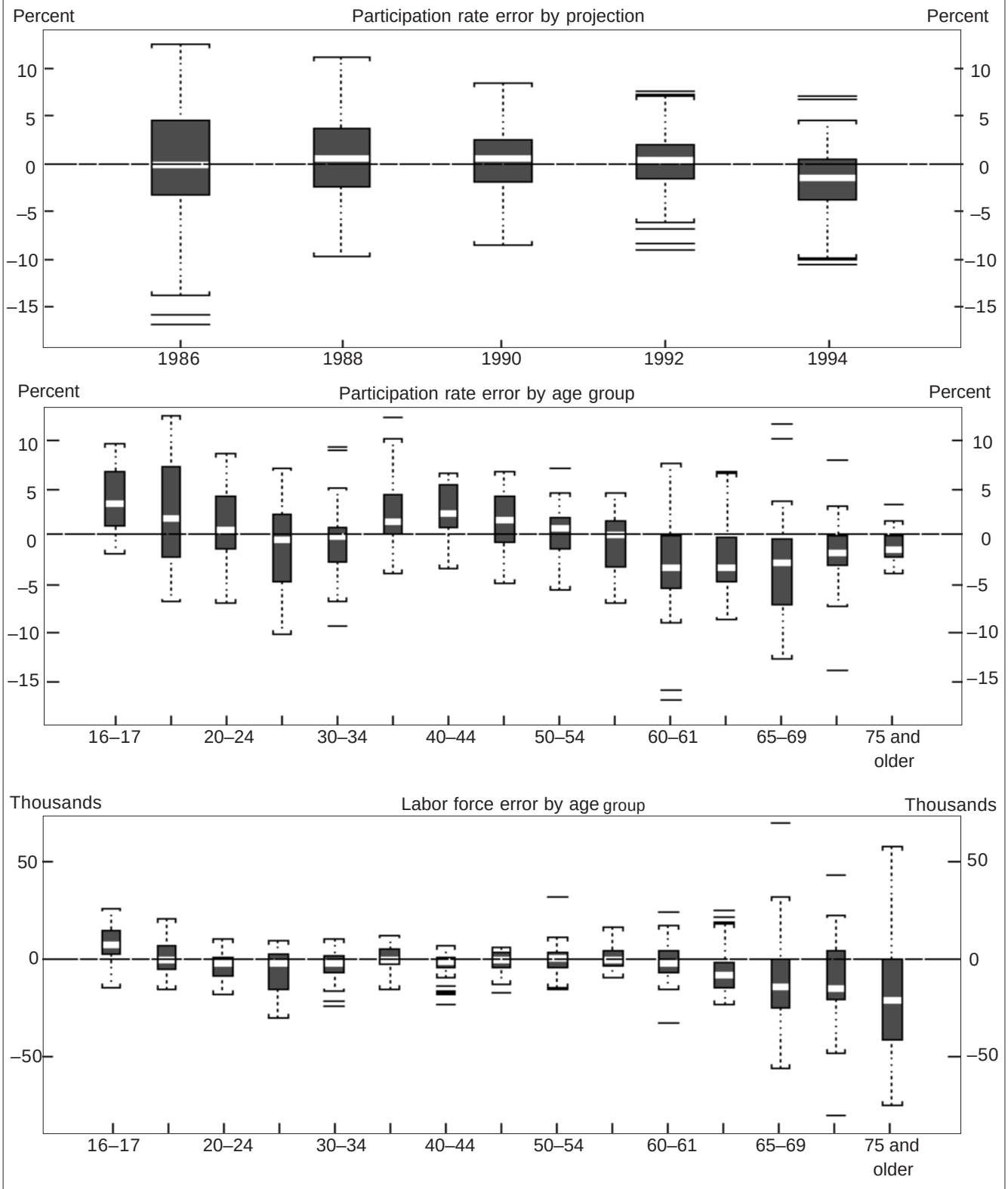
Error	1986	1988	1990	1992	1994
	Depth				
Lowest	–16.9	–9.8	–8.5	–9.0	–10.6
Lowest eighth	–5.8	–3.5	–2.6	–3.4	–4.9
Lowest quarter	–3.1	–2.1	–1.8	–1.3	–3.6
Half (median)	–.1	.6	.6	.4	–1.6
Highest quarter	3.1	3.5	2.3	1.8	.3
Highest eighth	6.6	6.1	4.3	3.4	1.7
Highest	12.4	11.1	8.3	7.6	7.1
	Dispersion				
Inner 50 percent	6.1	5.6	4.1	3.1	3.9

Labor force

At this point, it is clear that the labor force participation rate projections were, as a group, too high. However, the aggregate labor force was fairly accurately projected. As new labor force projections were reviewed within BLS, the reviewers have an independent estimate of the aggregate labor force and employment, which contributes to a more accurate overall labor force. In the face of low population projections, labor force participation rates were increased, resulting in an accurate projection of the labor force.

Sex and race or Hispanic origin. Historically, BLS labor force projections have been characterized as having projected labor force levels too high for men and too low for women. However, for 3 of the 5 projections in this evaluation, the projected labor force for men was lower than the actual. For women, all of the projected labor force levels were higher than the actual. Thus, the traditional view of BLS labor force projections is now wrong. For the two projections with the largest overall error, the male labor force was off by 2.2 million in 1986; women's labor force was off by 1.4 million in 1990. In the projection with least overall error, men and women's errors offset. In any case, there does not seem to be a pattern of projecting labor force better for one gender than the other.

Chart 1. Errors in 2000 for participation rates and labor force, by selected categories



Box-and-whisker plots

"A boxplot is a way to look at the overall shape of a set of data. The central box shows the data between the 'hinges' (roughly quartiles), with the median respresented by a line. 'Whiskers' go out to the extremes of the data, and very extreme points are shown by themselves." See W. N. Venables and B. D. Ripley, *Modern Applied Statistics with S-PLUS*, 2nd edition (New York, Springer, 1997), p.172.

The goal of box and whisker plotting is to examine distributions; in this case, the distribution of errors. The errors are centered on zero (that is, they have a median near zero). We would like them to be tightly distributed around zero. That means that the two quartiles would be near zero and the remaining errors would be near the upper and lower quartiles (the vertical lines would be short). We would like no outliers, however, they do exist in this analysis, and provide an interesting discussion.

The heavy white line in each box is the median. The upper and lower edges of the box are the quartiles or hinges. The horizontal lines above and below the box indicate the maximum and minimum values.

The following tabulation shows mean absolute percent errors for various aggregations:

	Projection for 2000 made in—				
	1986	*1988*	*1990*	*1992*	*1994*
Aggregate error	1.5	0.2	1.5	0.7	0.6
Mean absolute percent errors for—					
Sex	1.4	1.5	1.5	.7	.8
Race	6.2	5.9	4.7	3.9	3.4
Sex and race	6.3	5.6	5.5	4.0	4.1
Sex, race, and age ...	15.4	12.3	9.1	7.5	8.5

The first row of the tabulation substantiates the information from this section's overview. Once gender is taken into account, the 1988 projection error increases. The 1988 projection had a highly accurate projection of the level, but the labor force level was too low for men and too high for women. The accuracy of overall projections is the result of offsetting errors. The other four projections did not have large offsetting errors by sex. The more detailed measures reveal where the errors were made. Thus, taking race and Hispanic origin into account increases the error because less of the offset is concealed. In the 1988 and 1990 projections, the projected white labor force was too large, compared with those of the black and Asian and other groups, for which the labor force was projected too low. The 1994 projection accurately projected the white labor force, but that for blacks was almost a million low. For all the projections, Hispanics were underprojected, by substantial amounts.

Taking race and gender into account, the error in the 1994 projection rises because the accuracy of the white labor force level is due to sizable offsetting errors in the labor force levels of men and women. Once age, sex, race (and Hispanic origin) are taken into account, the errors increase, as offsetting errors of having some ages too high and others too low are taken into account. This shows the pattern of error decreasing from the 1986 projection to the 1992 projection, then increasing for the 1994 projection. However, the accuracy of the overall labor force was obtained through offsetting errors.

Age, sex, or race and Hispanic origin. Table 6 summarizes the cumulative errors for 108 categories of the labor force, ranked from most negative to most positive. The median of the individual errors are all small, but negative. The low quartiles or hinges are all negative and the high hinges are all positive—the errors are grouped around zero. The innerquartile range decreased from the 1986 projection to the 1992 projection, before a slight increase for the 1994 projection. However, the range and the inner 75 percent show a decrease through 1994. The errors for the 1994 projection were systematic, but not large.

The white population and labor force is significantly larger than the black, Hispanic, or Asian and other population and labor forces. Thus, the largest numerical errors are in white groups. For the 1986 through 1992 projections, the group with the largest overprojection was white women ages 35 to 39. For the 1994 projection, white women ages 40 to 44 had the greatest error. By comparison, for the first four projections, white men ages 20 to 24 were underprojected the most. For the 1994 projection, Hispanic men ages 25 to 34 were the group most underprojected.

The older labor force had the greatest relative errors. The labor force for these ages is small, so a modest numerical error

Table 6. Summary of errors in the components of the labor force for 5 years of the 2000 projection

[In thousands]

Error	1986	1988	1990	1992	1994
	Depth				
Lowest	–518	–543	–372	–326	–290
Lowest eighth	–244	–140	–118	–97	–100
Lowest quarter	–93	–75	–62	–43	–59
Half (median)	–16	–14	–4	–6	–13
Highest quarter ...	0	9	21	13	4
Highest eighth	39	55	97	61	26
Highest	712	772	563	765	230
	Dispersion				
Inner 50 percent ...	94	84	84	55	64
Inner 75 percent ...	282	195	215	158	126
Range	1,230	1,315	935	1,091	520

yields a large relative error. (See chart 1, bottom panel for relative errors by age group.) For those age groups with high labor force participation, the relative errors had a median of zero and the errors were closely grouped around the median. The labor force participation rate projections at the older ages, which were too low for older men, had negative median errors and wide dispersion around the median. Thus, the greatest errors in the labor force were at ages with modest impact on the size of the labor force.[5]

Distribution

For some users, the size and growth rate of the labor force is unimportant; the concern is for the distribution between men and women, among the various race and ethnic groups, or among the various age groups. The text tabulation (page 10) presents the index of dissimilarity comparing the projections to the 2000 actual, by various levels of aggregation.

Index of dissimilarity by—	*Projection for 2000 made in—*				
	1986	*1988*	*1990*	*1992*	*1994*
Sex	0.7	0.8	0.3	0.3	0.4
Race	.6	.8	.7	.5	.6
Race and sex	1.3	1.5	1.0	.9	.9
Race, sex, and age	3.3	2.6	2.0	1.9	1.3

The index of dissimilarity may be interpreted as the amount the one distribution has to change to be like another. In these cases, it records how much the projected distribution has to change to be like the actual 2000 labor force distribution. Thus, the 1986 projection would have had to change by 0.7 of a percentage point to reflect the actual distribution of the labor force between men and women. The projections were also quite good in reflecting the actual composition of the labor force by race. Taking race and gender into account, there is a higher index of dissimilarity (or greater error) than when considering race or only sex. However, in the worst year, 1988, the distribution would have only needed to change by 1.5 percentage points. Once race, sex, and age are all taken into account, the indexes increase again; however, they improve with time, as the worst year, 1986, is 3.3 percent and the best year, 1994, is 1.3 percent. Even though the older labor force was underprojected, the age composition of the labor force was fairly well projected.

Alternatives and confidence intervals

For each of the five labor force projections, BLS prepared three alternatives (low moderate and high). This analysis focuses on the middle or moderate alternative because BLS presents the middle alternative in its presentations. However, a user could reasonably expect the 2000 labor force to be between the low and high alternatives.

Table 7. High and low alternatives of the labor force for 5 years of the 2000 projection

Projection for 2000 made in—	High alternative		Low alternative	
	Labor force (thousands)	Participation rate	Labor force (thousands)	Participation rate
1986	141.1	68.0	134.5	65.7
1988	146.8	70.7	137.7	67.3
1990	156.2	71.5	141.8	66.1
1992	156.5	70.1	147.3	67.3
1994	153.4	68.7	143.6	65.5
Actual				
1994	140.9	67.2	140.9	67.2

Unlike projections for earlier years, some of these alternative projections did not cover the actual. (See table 7.) Only the projections prepared in 1986 bracketed or covered both the actual 2000 labor force and the participation rate. Given the characteristics of the projections with the labor force levels more accurately projected than the labor force participation rates, one would expect that the labor force projections would cover the actual and the labor force participation rates would not. For three of the projections, the low alternative labor force was higher than the 2000 actual. This happened for only two of the labor force participation rate projections. The 1992 projection was the only one to have neither the labor force or participation rate confidence interval cover the actual. Every possible combination of covering and not covering occurred among the five projections. Evaluations of projections to earlier years indicated that the actual labor force projection was covered by the alternatives.

THE PROCESS OF REVIEWING labor force projections helps provide a picture of the strengths and weaknesses of the BLS labor force projections model. Over time, this allows for improvements in that model. Faced with population projections that were too low, BLS made subtle adjustments in the labor force participation rate for the labor force ages 30 to 64, resulting in somewhat high aggregate labor force participation rates. For users of the labor force projections who needed projections of the size of the total labor force or of its growth rate, this projection would have served them well. For users of projected labor force participation rates, the problem was with projections for older workers, whose rates were too low. □

Notes

[1] Howard N Fullerton, Jr., "Labor force projections: 1986 to 2000," *Monthly Labor Review*, September 1987, pp. 19–29. Reprinted with additional detail in *Projections 2000*, BLS Bulletin 2302, March 1988. Howard N Fullerton, Jr., "New labor force projections, spanning 1988 to 2000," *Monthly Labor Review*, November 1989, pp. 3–12.

Reprinted with additional detail in *Outlook 2000*, BLS Bulletin 2352, April 1990. Howard N Fullerton, Jr., "Labor force projections: the baby boom moves on," *Monthly Labor Review*, November 1991, pp. 31–44. Reprinted with additional detail in *Outlook 1990–2005*, BLS Bulletin 2402, May 1992. Howard N Fullerton, Jr., "Another look at the labor force," *Monthly Labor Review*, November 1993, pp. 31–40. Reprinted with additional detail in *The American Work Force: 1992–2005*, BLS Bulletin 2452, April 1994. Howard N Fullerton, Jr., "The 2005 labor force: growing, but slowly," *Monthly Labor Review*, November 1995, pp. 29–44.

[2] Howard N Fullerton, Jr., "Evaluating the 1995 BLS labor force projections," *Proceedings of the Section on Government Statistics and Section on Social Statistics* (Alexandria, VA, American Statistical Association, 1997), pp. 394–99; Howard N, Fullerton, Jr., "An evaluation of labor force projections to 1990," *Monthly Labor Review*, August 1992, pp. 3–14; Howard N, Fullerton, Jr., "An evaluation of labor force projections to 1985," *Monthly Labor Review*, November 1988, pp. 7–17; Howard N, Fullerton, Jr., "How accurate were the 1980 labor force projections?," *Monthly Labor Review*, July 1982, pp. 15–21; Paul M. Ryscavage, "BLS labor force projections: a review of methods and results," *Monthly Labor Review*, April 1979, pp. 15–22; and Marc Rosenblum, "On the accuracy of labor force projections," *Monthly Labor Review*, October 1972, pp. 22–29.

[3] Projections of the Population of the United States by Age, Sex and Race: 1987 to 2080, *Current Population Reports*, Series P–25, no. 1018 (Bureau of the Census, 1989). Projections of the Population of the United States by Age, Sex and Race: 1993 to 2050, *Current Population Reports*, Series P–25, No. 1104 (Bureau of the Census, 1993). Projections of the Population of the United States by Age, Sex and Race: 1995 to 2050, *Current Population Reports*, Series P–25, no. 1130 (Bureau of the Census, 1995).

[4] Tammany Mulder, "Accuracy of the U.S. Census Bureau National Population Projections and Their Respective Components of Change," Population Division Working Paper No. 50 (Bureau of the Census, forthcoming).

[5] This is confirmed if a box and whisker chart of the errors in thousands is examined. If a user were particularly interested in the labor force participation of older workers or the size of their labor force, this set of projections would have been relatively unhelpful.